

## General

### Guideline Title

ACR Appropriateness Criteria® acute trauma to the foot.

### Bibliographic Source(s)

Bancroft LW, Kransdorf MJ, Adler R, Appel M, Beaman FD, Bernard SA, Bruno MA, Dempsey ME, Fries IB, Khoury V, Khurana B, Mosher TJ, Roberts CC, Tuite MJ, Ward RJ, Zoga AC, Weissman BN, Expert Panel on Musculoskeletal Imaging. ACR Appropriateness Criteria® acute trauma to the foot [online publication]. Reston (VA): American College of Radiology (ACR); 2014. 10 p. [49 references]

### Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Bennett DL, Daffner RH, Weissman BN, Bancroft L, Blebea JS, Bruno MA, Fries IB, Hayes CW, Kransdorf MJ, Luchs JS, Morrison WB, Roberts CC, Scharf SC, Stoller DW, Taljanovic MS, Tuite MJ, Ward RJ, Wise JN, Zoga AC, Expert Panel on Musculoskeletal Imaging. ACR Appropriateness Criteria® acute trauma to the foot. [online publication]. Reston (VA): American College of Radiology (ACR); 2010. 7 p. [28 references]

This guideline meets NGC's 2013 (revised) inclusion criteria.

## Recommendations

### Major Recommendations

ACR Appropriateness Criteria®

Clinical Condition: Acute Trauma to the Foot

Variant 1: Adult or child >5 years old. Acute injury to the foot; positive Ottawa Rules, suspicious for fracture. First study.

Radiologic Procedure	Rating	Comments	RRL*
X-ray foot	9		<input type="text"/>
CT foot without contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		The RRL for the adult procedure is <input type="text"/> .	*Relative Radiation

Radiologic Procedure	Rating	Comments	RRL*
CT foot without and with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/>
MRI foot without contrast	1		O
MRI foot without and with contrast	1		O
US foot	1		O
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: Adult or child >5 years old. Acute injury to the foot; does not meet the Ottawa Rules; no focal tenderness in the foot or palpable abnormality of the foot on physical examination; able to walk; neurologically intact (including no peripheral neuropathy). First study.

Radiologic Procedure	Rating	Comments	RRL*
X-ray foot	1		<input type="text"/>
CT foot without contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot without and with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
MRI foot without contrast	1		O
MRI foot without and with contrast	1		O
US foot	1		O
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 3: Adult or child >5 years old. Acute injury to the foot; does not meet the Ottawa Rules; patient is not neurologically intact and/or has a peripheral neuropathy that involves the feet. First study.

Radiologic Procedure	Rating	Comments	RRL*
X-ray foot	9		<input type="text"/>
CT foot without contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot without and with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative

MRI foot without contrast	1		O
Radiologic Procedure	Rating	Comments	RRL*
MRI foot without and with contrast	1		O
US foot	1		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 4: Adult or child >5 years old. Acute injury to the foot; does not meet the Ottawa Rules; patient has polytrauma. First study.

Radiologic Procedure	Rating	Comments	RRL*
X-ray foot	9		<input type="text"/>
CT foot without contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot without and with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
MRI foot without contrast	1		O
MRI foot without and with contrast	1		O
US foot	1		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 5: Adult or child >5 years old. Acute injury to the foot; does not meet the Ottawa Rules; physical examination is concerning for a Lisfranc injury. First study.

Radiologic Procedure	Rating	Comments	RRL*
X-ray foot	9		<input type="text"/>
X-ray foot with weight bearing	7		<input type="text"/>
CT foot without contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot without and with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
MRI foot without contrast	1		O
MRI foot without and with contrast	1		O
US foot	1		O

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate	Rating	Comments	*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 6: Adult or child >5 years old. Acute injury to the foot; physical examination is concerning for a Lisfranc injury. Radiographs are normal and patient is not able to tolerate a weight-bearing radiographic view. Next imaging study.

Radiologic Procedure	Rating	Comments	RRL*
MRI foot without contrast	9	MRI and CT are alternative examinations. Only one should be performed. MRI is preferred.	O
CT foot without contrast	9	MRI and CT are alternative examinations. Only one should be performed. MRI is preferred. The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot without and with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
MRI foot without and with contrast	1		O
US foot	1		O
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 7: Adult or child >5 years old. Acute injury to the foot; physical examination is concerning for an acute tendinous rupture or dislocation in the foot; radiographs are negative. Next imaging study.

Radiologic Procedure	Rating	Comments	RRL*
MRI foot without contrast	9		O
CT foot without contrast	5	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
US foot	5		O
CT foot without and with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
MRI foot without and with contrast	1		O
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 8: Adult or child >5 years old. Metatarsal-phalangeal joint injury. Suspect plantar plate injury. First study.

Radiologic Procedure	Rating	Comments	RRL*
X-ray foot	9		<input type="text"/>
X-ray foot with forced dorsiflexion lateral	5		<input type="text"/>
Fluoroscopy foot	5		<input type="text"/>
MRI foot without contrast	5		O
CT foot without contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot without and with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
MRI foot without and with contrast	1		O
US foot	1		O
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 9: Adult or child >5 years old. Acute injury to the foot; physical examination is concerning for penetrating trauma with a foreign body in the soft tissues. First study.

Radiologic Procedure	Rating	Comments	RRL*
X-ray foot	9		<input type="text"/>
US foot	7	Consider this procedure if the foreign body is known to be not radiopaque.	O
CT foot without contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot without and with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
MRI foot without contrast	1		O
MRI foot without and with contrast	1		O
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 10: Adult or child >5 years old. Acute injury to the foot; physical examination is concerning for penetrating trauma with a foreign body in the soft tissues. Radiographs of the foot are negative. Next best study.

Radiologic Procedure	Rating	Comments	RRL*
US foot	9		O
CT foot without contrast	5	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
MRI foot without contrast	5		O
CT foot with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
CT foot without and with contrast	1	The RRL for the adult procedure is <input type="text"/> .	<input type="text"/> <input type="text"/>
MRI foot without and with contrast	1		O
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

### Summary of Literature Review

#### Introduction/Background

In the setting of acute trauma to the foot, the clinical indications for medical imaging (known as the Ottawa Rules) have been well documented by multiple studies. The most commonly accepted form of these rules for the foot is the following:

A series of foot radiographs is required only if there is pain in the midfoot and any one of the following:

1. Point bone tenderness of the navicular
2. Point bone tenderness of the base of the fifth metatarsal OR
3. Inability to bear weight

A meta-analysis (10 studies encompassing 3,725 patients) of the Ottawa Rules for the foot showed that these rules have a sensitivity of 99.0% and a median specificity of 26% for combined evaluation of the ankle and midfoot. However, multiple conditions or scenarios preclude the use of the Ottawa Rules for determining if medical imaging is necessary. It has been reported that the Ottawa Rules for the foot should not be used or should be used with great caution in the following clinical situations: penetrating trauma, pregnancy, any skin wound, transferred with radiographs already taken, greater than 10 days after trauma, a return visit for continued traumatic foot pain, the setting of polytrauma, altered sensorium, neurologic abnormality affecting the foot, or underlying bone disease. The Ottawa Rules for the ankle and foot have been shown to be effective for the pediatric population (greater than 5 years of age). Including the added criterion of swelling yields a sensitivity and specificity for fracture of 100% and 55% for the malleolar zone and 50% and 40% for the midfoot, respectively.

Other clinical scenarios of foot trauma not directly addressed by the Ottawa Rules include trauma to the metatarsal heads and toes and penetrating trauma with concern for a foreign body in the soft tissues. There is little in the literature on medical decision-making about when to order a radiographic study of the toes. In general, if a fracture of a toe is suspected, radiographs can document or rule out a fracture. If radiographs are negative, magnetic resonance imaging (MRI) may be obtained in select patients with forefoot pain due to its increased sensitivity for the early detection of metatarsal head subchondral fracture. Both radiographs and ultrasound (US) are useful medical imaging tools to exclude a foreign body in the setting of penetrating trauma to the foot.

#### Overview of Imaging Modalities

Radiographs are the mainstay of initial medical imaging in the setting of acute foot trauma. Initial imaging typically consists of a 3-view study with the possibility of additional views as indicated by the clinical setting. Computed tomography (CT) is commonly used in evaluating the true extent of osseous injury in complex fractures and at times is used as the initial medical imaging study in polytrauma patients and in complex regions such as

the midfoot. In the polytrauma patient, approximately 25% of foot fractures seen on CT are overlooked on radiographs. Therefore, CT is essential for appropriate treatment planning and determining the true extent of osseous injuries in the polytrauma patient.

Both MRI and US are used in evaluating soft-tissue injuries of the foot in the setting of acute trauma, especially when radiographs are noncontributory. Both modalities have a similar sensitivity for acute soft-tissue trauma about the ankle and foot such as ligamentous and tendinous disruption. The choice of modality is usually determined by costs, availability of technology, and availability of expert musculoskeletal sonographers and interpreters. MRI is also the most sensitive modality for the detection of occult fracture and acute bone stress changes.

#### Discussion of Imaging Modalities by Variant

*Variant 1: Adult or Child >5 Years Old. Acute Injury to the Foot; Positive Ottawa Rules, Suspicious for Fracture. First Study.*

*Variant 2: Adult or Child >5 Years Old. Acute Injury to the Foot; Does Not Meet the Ottawa Rules; No Focal Tenderness in the Foot or Palpable Abnormality of the Foot on Physical Examination; Able to Walk; Neurologically Intact (Including No Peripheral Neuropathy). First Study.*

The Ottawa Rules for acute trauma to the foot are fairly well established and have been validated by multiple institutional trials verifying the 99% sensitivity in determining the presence of a foot fracture. The more serious potential problems in determining the need for imaging occur in the patient who does not meet the inclusion criteria for medical imaging by the Ottawa Rules of the foot. These criteria are stated in the introduction above. One should carefully evaluate the patient to make sure they do not meet any of the exclusionary criteria before implementing the Ottawa Rules. A preliminary sonographic study has had less successful results compared to radiographic evaluation, with 90.9% sensitivity and specificity.

*Variant 3: Adult or Child >5 Years Old. Acute Injury to the Foot; Does Not Meet the Ottawa Rules; Patient is Not Neurologically Intact and/or Has a Peripheral Neuropathy That Involves the Feet. First Study.*

In diabetics or other patients with a neuropathy that affects the feet, the traumatized foot should be radiographed. The Ottawa Rules should not be applied in this clinical setting since pain perception may be diminished, no point tenderness will be elicited with palpation, and the patient may be able to ambulate even if a fracture is present. As well, it is not clinically possible to utilize the Ottawa Rules when the patient is neurologically compromised. If a foot fracture is suspected in a neurologically compromised patient, the foot should be imaged.

*Variants 4: Adult or Child >5 Years Old. Acute Injury to the Foot; Does Not Meet the Ottawa Rules; Patient Has Polytrauma. First Study.*

General practice is to radiograph the foot; however, data can support using CT as the initial imaging modality in polytrauma patients, including those patients who are neurologically compromised. In one study of polytrauma patients, 25% of foot fractures demonstrated on CT were not detectable on radiographs.

*Variant 5: Adult or Child >5 Years Old. Acute Injury to the Foot; Does Not Meet the Ottawa Rules; Physical Examination is Concerning for a Lisfranc Injury. First Study.*

*Variant 6: Adult or Child >5 Years Old. Acute Injury to the Foot; Physical Examination is Concerning for a Lisfranc Injury. Radiographs Are Normal and Patient is Not Able to Tolerate a Weight-bearing Radiographic View. Next Imaging Study.*

Where there is a fairly high clinical suspicion of an acute Lisfranc injury, the foot should be imaged. In addition to a typical 3-view radiographic study of the foot (anteroposterior [AP], oblique, and lateral), a weight-bearing AP view with 20° craniocaudal angulation can be added. Weight-bearing views have been shown to increase the abnormal alignment at the first intermetatarsal space, thus making it easier to identify a Lisfranc injury. There is also debate as to whether radiography should be the initial imaging modality in the setting of a suspected Lisfranc injury, since patients with Lisfranc sprains may incur ligamentous damage without diastasis. CT and MRI have been advocated as the best medical imaging tests (especially if the patient is not able to bear weight), and 3-D volumetric acquisitions have proven superiority over orthogonal proton density fat-suppressed imaging. Recently, it has been shown that there is a high correlation between MRI and intraoperative findings for an unstable Lisfranc injury. CT is also useful in demonstrating the multiple metatarsal and cuneiform fractures that can be associated with a ligamentous Lisfranc injury. In the patient with a suspected Lisfranc injury and normal radiographs, the literature supports further advanced imaging by MRI and CT. Finally, US may hold promise as another method to accurately evaluate for a significant Lisfranc injury; however, further studies will be needed to confirm this.

*Variant 7: Adult or Child >5 Years Old. Acute Injury to the Foot; Physical Examination is Concerning for an Acute Tendinous Rupture or Dislocation in the Foot; Radiographs Are Negative. Next Imaging Study.*

Both MRI and US have been shown to be sensitive for the diagnosis of acute tendon rupture or dislocation in the foot. In a surgically confirmed

study, MRI was shown to have 83% sensitivity for diagnosing tendon and ligament traumatic injuries about the foot and ankle. Both MRI and US have been shown to have similar sensitivities for tendon injuries about the foot and ankle, specifically the tibialis posterior tendon. US has also been reported to have a high sensitivity for peroneal tendon tears. One has to weigh several factors when deciding between MRI and US for evaluating an acute soft-tissue injury of the foot, including cost and availability of health-care providers who are adept at performing and/or interpreting musculoskeletal US. Protocol-based sonographic evaluation identified 97.4% of symptomatic abnormalities in the distal extremities (including the foot), with additional accuracy obtained with focused examination. MRI tends to be used as a screening tool when one is not certain of the specific tendon injury or if concomitant osseous injury is suspected. Finally, CT is typically used for preoperative planning for fracture treatment and evaluation. However, volume-rendered CT imaging has been shown to be a quick and effective way of documenting peroneal tendon dislocations, which are associated with comminuted calcaneal fractures.

*Variant 8: Adult or Child >5 Years Old. Metatarsal-Phalangeal Joint Injury. Suspect Plantar Plate Injury. First Study.*

The best initial imaging study for evaluating hallux plantar plate disruption after metatarsal-phalangeal (MTP) joint injury is weight-bearing AP, lateral, and sesamoid axial views. Patients with plantar plate rupture will have proximal migration of one or both hallux sesamoids. The sesamoids will not track distally with great toe extension at the MTP joint on forced dorsiflexion lateral view or fluoroscopy. US in the sagittal plane best visualizes the plantar plate between the flexor tendon and hyaline cartilage of the metatarsal head. Tears may be partial or complete and mainly involve the second toe, and less commonly the third and fourth toes. US has shown a 96% sensitivity compared with 87% sensitivity of MRI for the detection of lesser toe plantar plate tears, however both modalities have poor specificity. MRI is the preferred imaging method for evaluating suspected "turf toe," by directly evaluating the soft-tissue structures of the capsuloligamentous complex as well as assessing chondral and osteochondral lesions.

*Variant 9: Adult or Child >5 Years Old. Acute Injury to the Foot; Physical Examination is Concerning for Penetrating Trauma with a Foreign Body in the Soft Tissues. First Study.*

*Variant 10: Adult or Child >5 Years Old. Acute Injury to the Foot; Physical Examination is Concerning for Penetrating Trauma with a Foreign Body in the Soft Tissues. Radiographs of the Foot Are Negative. Next Best Study.*

The best initial imaging study for a foreign body in the foot depends on whether or not the suspected foreign body is radiopaque (e.g., as gravel, glass, or metal). Radiographic evaluation for a radiopaque foreign body has an approximately 98% sensitivity. If an unembedded fragment of the foreign body is available, then imaging it alongside the foot might provide more information as to the morphology and density of the foreign body. US is the imaging modality of choice if the foreign body is not radiopaque (e.g., wood or plastic), with a reported 90% sensitivity for visualizing wooden foreign bodies. One study reported an overall sensitivity and specificity for detection of a variety of foreign bodies (e.g., fresh wood, dry wood, glass, porcelain, and plastic fragments) of 29% and 100% with radiographs, 63% and 98% with CT, and 58% and 100% with MRI.

#### Summary of Recommendations

- If a patient with acute foot trauma fits the inclusion criteria for the Ottawa Rules and meets the Ottawa Rules' criteria for imaging, the first imaging study should be a 3-view radiographic series of the foot.
- If a patient with acute foot trauma does not meet the inclusion criteria to be evaluated by the Ottawa Rules (such as a diabetic with peripheral neuropathy involving the foot), then imaging should be obtained. The first imaging study in this scenario should be a 3-view radiographic series of the foot.
- If there is clinical concern for a midfoot injury (such as a Lisfranc injury), then imaging should be performed. The first imaging study in this situation is usually a 3-view radiographic series of the foot with weight bearing on at least the AP view, if possible. If there is continued clinical concern for a Lisfranc injury in the setting of a normal radiograph, then advanced imaging (MRI or CT) should be considered and performed on a case-by-case basis. Likewise, when there is clinical concern for an acute tendon rupture, further imaging with MRI or US would be confirmatory.
- If there is clinical suspicion for plantar plate injury after MTP joint injury, radiography is the initial imaging modality. Weight-bearing AP, lateral, and sesamoid axial views may detect proximal migration of one or both hallux sesamoids with great toe injuries. US and MRI can directly evaluate the soft-tissue structures of the capsuloligamentous complex, specifically the plantar plate.
- In the setting of penetrating trauma to the foot with a possible foreign body, radiography (if the foreign body is radiopaque) or US (with nonradiopaque foreign bodies) should be used to determine if a foreign body is indeed present.

#### Abbreviations

- CT, computed tomography
- MRI, magnetic resonance imaging
- US, ultrasound



Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
<div></div>	<0.1 mSv	<0.03 mSv
<div><div></div><div></div></div>	0.1-1 mSv	0.03-0.3 mSv
<div><div></div><div></div><div></div></div>	1-10 mSv	0.3-3 mSv
<div><div></div><div></div><div></div><div></div></div>	10-30 mSv	3-10 mSv
<div><div></div><div></div><div></div><div></div><div></div></div>	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."		

Clinical Algorithm(s)

Algorithms were not developed from criteria guidelines.

Scope

Disease/Condition(s)

Acute trauma to the foot

Guideline Category

Diagnosis

Evaluation

Clinical Specialty

Emergency Medicine

Orthopedic Surgery

Pediatrics

Podiatry

Radiology

Sports Medicine

Intended Users

Health Care Providers

Health Plans

Hospitals

Physician Assistants

Physicians

Podiatrists

Utilization Management

## Guideline Objective(s)

To evaluate the appropriateness of imaging modalities for the evaluation of patients with acute foot trauma

## Target Population

Patients with acute foot trauma

## Interventions and Practices Considered

1. X-ray, foot
  - With weight bearing
  - Forced dorsiflexion lateral
2. Computed tomography (CT), foot
  - Without contrast
  - With contrast
  - Without and with contrast
3. Magnetic resonance imaging (MRI), foot
  - Without contrast
  - Without and with contrast
4. Ultrasound (US), foot
5. Fluoroscopy

## Major Outcomes Considered

- Utility of radiologic examinations in differential diagnosis
- Sensitivity and specificity of radiologic examinations

## Methodology

### Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

### Description of Methods Used to Collect/Select the Evidence

Literature Search Summary

Of the 28 citations in the original bibliography, 27 were retained in the final document. Articles were removed from the original bibliography if they were more than 10 years old and did not contribute to the evidence or they were no longer cited in the revised narrative text.

A new literature search was conducted in August 2012 to identify additional evidence published since the *ACR Appropriateness Criteria® Acute Trauma to the Foot* topic was finalized. Using the search strategy described in the literature search companion (see the "Availability of Companion Documents" field), 45 articles were found. Three articles were added to the bibliography. Forty-two articles were not used due to either poor study design, the articles were not relevant or generalizable to the topic, the results were unclear, misinterpreted, or biased, or the articles were already cited in the original bibliography.

The author added 19 citations from bibliographies, Web sites, or books that were not found in the new literature search.

See also the American College of Radiology (ACR) Appropriateness Criteria® literature search process document (see the "Availability of Companion Documents" field) for further information.

## Number of Source Documents

Of the 28 citations in the original bibliography, 27 were retained in the final document. The new literature search conducted in August 2012 identified three articles that were added to the bibliography. The author added 19 citations from bibliographies, Web sites, or books that were not found in the new literature search.

## Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

### Rating Scheme for the Strength of the Evidence

Study Quality Category Definitions

Category 1 - The study is well-designed and accounts for common biases.

Category 2 - The study is moderately well-designed and accounts for most common biases.

Category 3 - There are important study design limitations.

Category 4 - The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:

- a. The study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description).
- b. The study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence.
- c. The study is an expert opinion or consensus document.

## Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

### Description of the Methods Used to Analyze the Evidence

The topic author assesses the literature then drafts or revises the narrative summarizing the evidence found in the literature. American College of Radiology (ACR) staff drafts an evidence table based on the analysis of the selected literature. These tables rate the study quality for each article included in the narrative.

The expert panel reviews the narrative, evidence table and the supporting literature for each of the topic-variant combinations and assigns an appropriateness rating for each procedure listed in the variant table(s). Each individual panel member assigns a rating based on his/her interpretation of the available evidence.

More information about the evidence table development process can be found in the ACR Appropriateness Criteria® Evidence Table Development documents (see the "Availability of Companion Documents" field).

## Methods Used to Formulate the Recommendations

Expert Consensus (Delphi)

## Description of Methods Used to Formulate the Recommendations

### Rating Appropriateness

The American College of Radiology (ACR) Appropriateness Criteria (AC) methodology is based on the RAND Appropriateness Method. The appropriateness ratings for each of the procedures or treatments included in the AC topics are determined using a modified Delphi method. A series of surveys are conducted to elicit each panelist's expert interpretation of the evidence, based on the available data, regarding the appropriateness of an imaging or therapeutic procedure for a specific clinical scenario. The expert panel members review the evidence presented and assess the risks or harms of doing the procedure balanced with the benefits of performing the procedure. The direct or indirect costs of a procedure are not considered as a risk or harm when determining appropriateness. When the evidence for a specific topic and variant is uncertain or incomplete, expert opinion may supplement the available evidence or may be the sole source for assessing the appropriateness.

The appropriateness is represented on an ordinal scale that uses integers from 1 to 9 grouped into three categories: 1, 2, or 3 are in the category "usually not appropriate" where the harms of doing the procedure outweigh the benefits; and 7, 8, or 9 are in the category "usually appropriate" where the benefits of doing a procedure outweigh the harms or risks. The middle category, designated "may be appropriate", is represented by 4, 5, or 6 on the scale. The middle category is when the risks and benefits are equivocal or unclear, the dispersion of the individual ratings from the group median rating is too large (i.e., disagreement), the evidence is contradictory or unclear, or there are special circumstances or subpopulations which could influence the risks or benefits that are embedded in the variant.

The ratings assigned by each panel member are presented in a table displaying the frequency distribution of the ratings without identifying which members provided any particular rating. To determine the panel's recommendation, the rating category that contains the median group rating without disagreement is selected. This may be determined after either the first or second rating round. If there is disagreement after the second rating round, the recommendation is "May be appropriate."

This modified Delphi method enables each panelist to articulate his or her individual interpretations of the evidence or expert opinion without excessive influence from fellow panelists in a simple, standardized and economical process. For additional information on the ratings process see the [Rating Round Information](#)  document on the ACR Web site.

Additional methodology documents, including a more detailed explanation of the complete topic development process and all ACR AC topics can be found on the [ACR Web site](#)  (see also the "Availability of Companion Documents" field).

## Rating Scheme for the Strength of the Recommendations

Not applicable

## Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

## Method of Guideline Validation

Internal Peer Review

## Description of Method of Guideline Validation

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

## Evidence Supporting the Recommendations

### Type of Evidence Supporting the Recommendations

The recommendations are based on analysis of the current literature and expert panel consensus.

#### Summary of Evidence

Of the 50 references cited in the *ACR Appropriateness Criteria® Acute Trauma to the Foot* document, all of them are categorized as diagnostic references including 2 well-designed studies, 9 good quality studies, and 16 quality studies that may have design limitations. There are 23 references that may not be useful as primary evidence.

While there are references that report on studies with design limitations, 11 well-designed or good quality studies provide good evidence.

## Benefits/Harms of Implementing the Guideline Recommendations

### Potential Benefits

Selection of appropriate radiologic imaging procedures for evaluation of acute trauma of the foot

### Potential Harms

#### Gadolinium-based Contrast Agents

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e.,  $<30$  mL/min/1.73 m<sup>2</sup>), and almost never in other patients. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates  $<30$  mL/min/1.73 m<sup>2</sup>. For more information, please see the American College of Radiology (ACR) Manual on Contrast Media (see the "Availability of Companion Documents" field).

#### Relative Radiation Level

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document (see the "Availability of Companion Documents" field).

## Qualifying Statements

### Qualifying Statements

The American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

## Implementation of the Guideline

### Description of Implementation Strategy

An implementation strategy was not provided.

## Institute of Medicine (IOM) National Healthcare Quality Report Categories

### IOM Care Need

Getting Better

### IOM Domain

Effectiveness

## Identifying Information and Availability

### Bibliographic Source(s)

Bancroft LW, Kransdorf MJ, Adler R, Appel M, Beaman FD, Bernard SA, Bruno MA, Dempsey ME, Fries IB, Khoury V, Khurana B, Mosher TJ, Roberts CC, Tuite MJ, Ward RJ, Zoga AC, Weissman BN, Expert Panel on Musculoskeletal Imaging. ACR Appropriateness Criteria® acute trauma to the foot [online publication]. Reston (VA): American College of Radiology (ACR); 2014. 10 p. [49 references]

### Adaptation

Not applicable: The guideline was not adapted from another source.

### Date Released

2010 (revised 2014)

## Guideline Developer(s)

American College of Radiology - Medical Specialty Society

## Source(s) of Funding

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

## Guideline Committee

Committee on Appropriateness Criteria, Expert Panel on Musculoskeletal Imaging

## Composition of Group That Authored the Guideline

*Panel Members:* Laura W. Bancroft, MD (*Principal Author*); Mark J. Kransdorf, MD (*Panel Vice-chair*); Ronald Adler, MD, PhD; Marc Appel, MD; Francesca D. Beaman, MD; Stephanie A. Bernard, MD; Michael A. Bruno, MD; Molly E. Dempsey, MD; Ian Blair Fries, MD; Viviane Khoury, MD; Bharti Khurana, MD; Timothy J. Mosher, MD; Catherine C. Roberts, MD; Michael J. Tuite, MD; Robert J. Ward, MD; Adam C. Zoga, MD; Barbara N. Weissman, MD (*Panel Chair*)

## Financial Disclosures/Conflicts of Interest

Not stated

## Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Bennett DL, Daffner RH, Weissman BN, Bancroft L, Blebea JS, Bruno MA, Fries IB, Hayes CW, Kransdorf MJ, Luchs JS, Morrison WB, Roberts CC, Scharf SC, Stoller DW, Taljanovic MS, Tuite MJ, Ward RJ, Wise JN, Zoga AC, Expert Panel on Musculoskeletal Imaging. ACR Appropriateness Criteria® acute trauma to the foot. [online publication]. Reston (VA): American College of Radiology (ACR); 2010. 7 p. [28 references]

This guideline meets NGC's 2013 (revised) inclusion criteria.

## Guideline Availability

Electronic copies: Available from the [American College of Radiology \(ACR\) Web site](#) .

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

## Availability of Companion Documents

The following are available:

- ACR Appropriateness Criteria®. Overview. Reston (VA): American College of Radiology; 2015 Feb. 3 p. Electronic copies: Available from the [American College of Radiology \(ACR\) Web site](#) .
- ACR Appropriateness Criteria®. Literature search process. Reston (VA): American College of Radiology; 2015 Feb. 1 p. Electronic copies: Available from the [ACR Web site](#) .
- ACR Appropriateness Criteria®. Evidence table development – diagnostic studies. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available from the [ACR Web site](#) .
- ACR Appropriateness Criteria®. Radiation dose assessment introduction. Reston (VA): American College of Radiology; 2015 Feb. 3 p.

Electronic copies: Available from the [ACR Web site](#) .

- ACR Appropriateness Criteria®. Procedure information. Reston (VA): American College of Radiology; 2015 Feb; 2 p. Electronic copies: Available from the [ACR Web site](#) .
- ACR Appropriateness Criteria® Manual on contrast media. Reston (VA): American College of Radiology; 2013. 128 p. Electronic copies: Available from the [ACR Web site](#) .
- ACR Appropriateness Criteria® acute trauma to the foot. Evidence table. Reston (VA): American College of Radiology; 2014. 17 p. Electronic copies: Available from the [ACR Web site](#) .
- ACR Appropriateness Criteria® acute trauma to the foot. Literature search. Reston (VA): American College of Radiology; 2014. 1 p. Electronic copies: Available from the [ACR Web site](#) .

## Patient Resources

None available

## NGC Status

This NGC summary was completed by ECRI Institute on September 19, 2011. This NGC summary was updated by ECRI Institute on April 9, 2015.

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